OATEN HAY AGRONOMY – WIMMERA

Alison Frischke, Genevieve Clarke (BCG) and Georgie Troup (DPIRD, WA)

TAKE HOME MESSAGES

- Longer season varieties and later sowing took advantage of the higher-than-average spring rainfall.
- Hay yield was optimised by sowing longer season varieties Vasse and Wintaroo at the end of May in 2020 in the Wimmera.
- Delaying sowing from 6 May to 29 May increased hay yield by 0.6t/ha on average.
- Most varieties responded to increasing rates of nitrogen to 90kg N/ha, except WA varieties Carrolup and Koorabup.
- Yallara yield was optimised at 90kg N, while Mulgara and Wintaroo responded to 120kg N before plateauing.
- Later sowing benefited leaf greenness and stem diameter in 2020 with good spring rainfall.

BACKGROUND

Oaten hay accounts for almost 75 per cent of fodder exported from Australia, to key export markets such as Japan, Korea, China and Taiwan.

Hay exporters take a subjective and objective approach to determining hay quality. In the paddock they will generally look for visual indicators such as colour, stem thickness, texture and smell. Objective feed testing measures levels of metabolisable energy, sugars (water soluble carbohydrates, WSC), protein, fibre (NDF and ADF) and digestibility. These combine to determine palatability, animal intake and performance. Ideally, exporters are seeking thin stemmed, soft textured hay, with high WSC and low in fibre (NDF≤50-55% and ADF≤30-35%) (Peace 2016) that is more palatable and sought after by the international markets.

The National Hay Agronomy project is a four-year investment by the AgriFutures Export Fodder Program led by DPIRD with BCG, Agriculture Victoria, NSW DPI and SARDI. The project, now in its second year, aims to improve the understanding of how agronomic practices affect export oaten hay yield and quality. This will help growers better manage oaten hay crops to meet export market specifications and develop a competitive advantage in our export fodder markets.

AIM

To evaluate hay yield and quality of oat varieties at different times of sowing and under different nitrogen (N) nutrition strategies.

PADDOCK DETAILS

Location: Rupanyup

Crop year rainfall (Nov-Oct): 467mm

GSR (Apr-Oct): 309mm

Ave GSR (Apr-Oct): 292mm

Soil type: Clay

Paddock history: 2019 barley

TRIAL DETAILS

Crop type/s: Oats

Treatments: Refer to Table 1

Target plant density: 320 plants/m^2

Seeding equipment: Knife points, press wheels, 30cm row spacing

Sowing dates: Refer to Table 1

Replicates: Three

Trial average yield: 6.3t/ha

Table 1. Treatment outline: Oat varieties, time of sowing and N rate, Rupanyup 2020.

Variety characteristics				Time of sowing	N rate* (kg N/ha)
Variety	**End use**	**Height**	**Maturity**		
Brusher	Hay/grazing/feed grain	Tall	Quick	6 May	10**
Carrolup	Milling/hay	Mod tall	Quick	29 May	30
Durack	Milling/hay	Mod tall	Very quick		60
Koorabup	Hay	Mod tall	Mid-quick		90
Mulgara	Hay/feed	Tall	Quick		120**
Vasse	Hay	Mod tall	Mid-slow		150**
Williams	Milling/hay	Short-tall	Quick		
Wintaroo	Hay/grazing	Tall	Mid		
Yallara	Milling/hay	Mod tall	Quick		

*Nitrogen applied as two thirds at sowing and one third 6 weeks post sowing

** Mulgara, Wintaroo and Yallara only

TRIAL INPUTS

Fertiliser: Granulock® Supreme Z + Flutriafol (200ml/100kg) @ 60kg/ha

Seed treatment: EverGol® @ 260mL/100kg and Gaucho® @ 240mL/100kg

Trial managed as per best practice for herbicides, insecticides and fungicides.

METHOD

A replicated field trial was sown using a split plot trial design. Treatments from the 2019 Oaten Hay Agronomy trial were repeated, except for the variety Forester (very slow maturity) which was swapped for Vasse; a mid-slow variety more suited to the Wimmera.

Assessments included NDVI, hay biomass at GS71, plant height, lodging, leaf greenness (SPAD chlorophyll measure) and stem diameter. NIR (including DairyOne calibration) was being analysed at the time of writing.

RESULTS AND INTERPRETATION

2020 time of sowing (TOS) effects contrasted with the 2019 trial at Kalkee which experienced a dry spring finish.

In 2019 yields at Kalkee were favoured by earlier sowing, with early May sown treatments averaging 1.5t/ha higher than early June sown treatments (Figure 1). The late maturing Forester failed to reach GS71 for hay cut at either sowing date.

Yield in 2019 was generally optimised with the application of 60kgN/ha split 2:1 between sowing and top dressing six weeks post sowing.

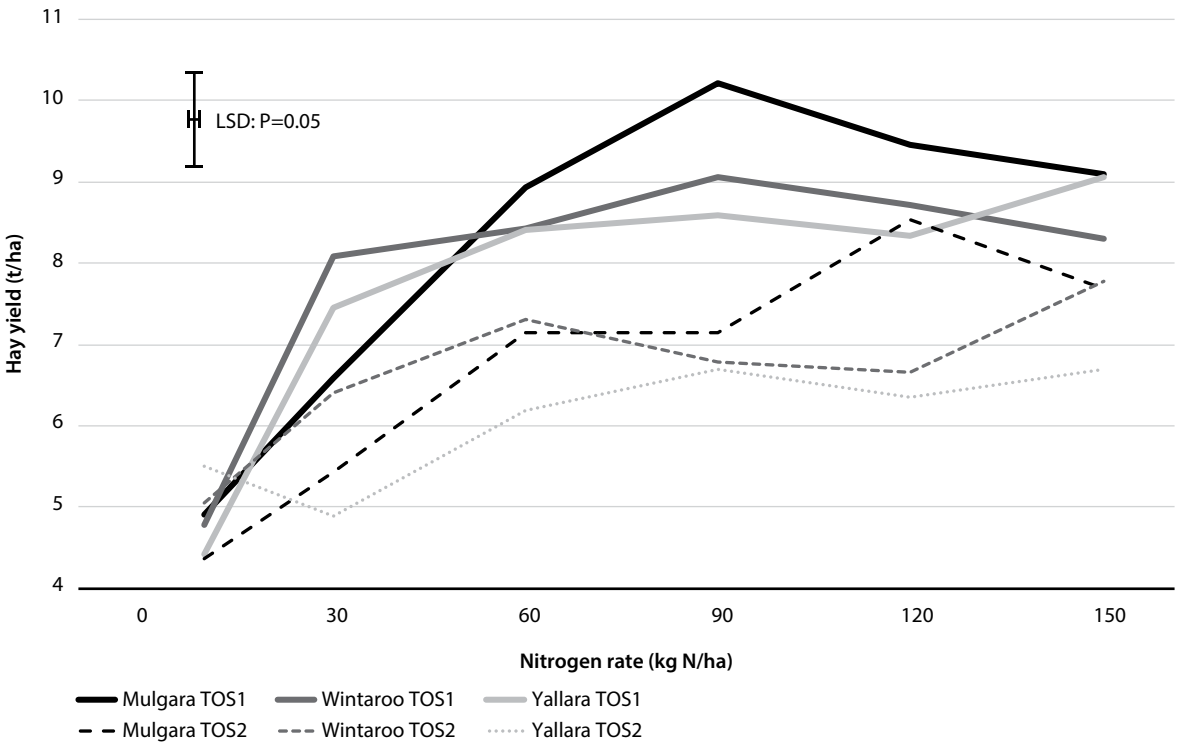

Figure 1. Mean oaten hay yield response to six nitrogen rates and two sowing dates, Kalkee 2019. Stats: TOS x Variety x N: P=0.038, LSD=1.2t/ha, CV=9.7%.

The 2020 season at Rupanyup experienced a very good start with 189mm rainfall falling between January and April, providing soil moisture to support below average rainfall months between May to July (77mm). In August and September, 66mm and 41mm fell respectively resulting in mild conditions as the trial moved through stem elongation until it was ready to cut (Figure 2).

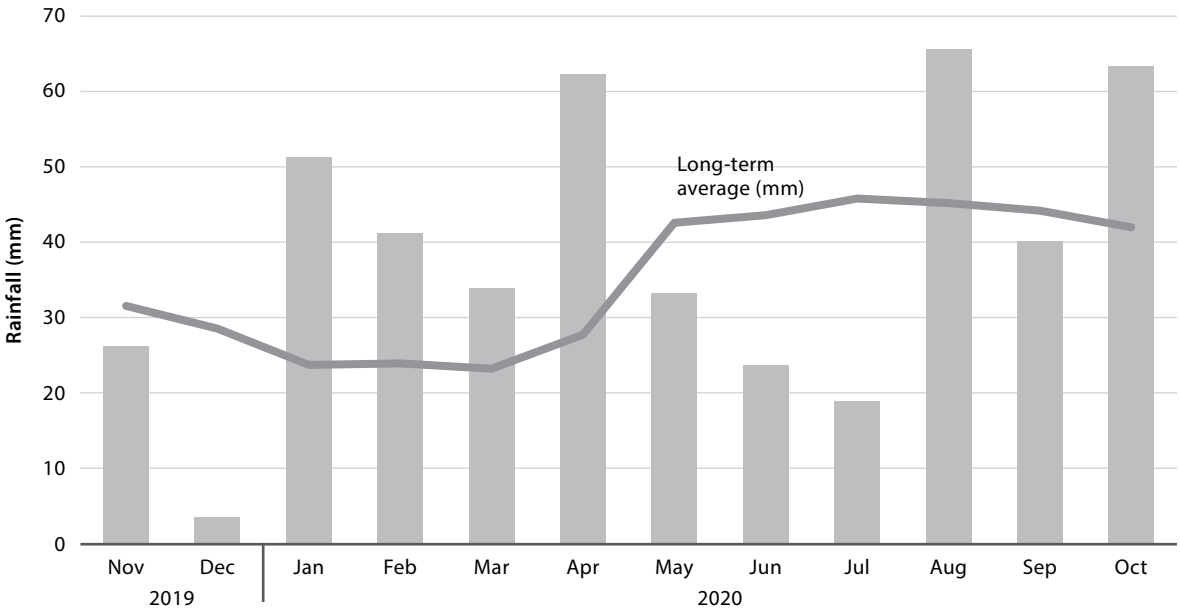

Figure 2. Average rainfall and growing season rainfall received at Rupanyup, 2020.

Across the trial, hay yields averaged 6.3t/ha.

Hay yield was influenced by variety selection, sowing date and rate of applied nitrogen. There was no three-way interaction between the factors but there were two-way interactions between each.

Time of sowing

An interaction between sowing date and variety reflected the different maturity types and the nature of the season.

On average, varieties sown at the end of May benefited from the good spring and produced 0.6 t/ha more hay than varieties sown three weeks earlier at the start of May. It is likely the TOS 1 plants became stressed during stem elongation or booting during July. Water stress during the critical growth extension phase can result in varieties rushing through and not accumulating as much biomass. TOS 2 plants sown three weeks later would not have reached that growth stage and experienced the same moisture stress, then were better able to capitalise on the extra water availability in spring.

The slowest varieties had the greatest time of sowing differences: mid-slow Vasse capitalised most producing 1.6t/ha more to achieve the highest yield of 8.1 t/ha when sown later, followed by mid maturing Wintaroo producing 1.3t/ha more to yield 7.0 t/ha. Other varieties that had faster maturities were comparable between sowing times with the good growing conditions. Fast maturing varieties Carrolup and Durack had the lowest yields in the trial when sown in early May (Figure 3).

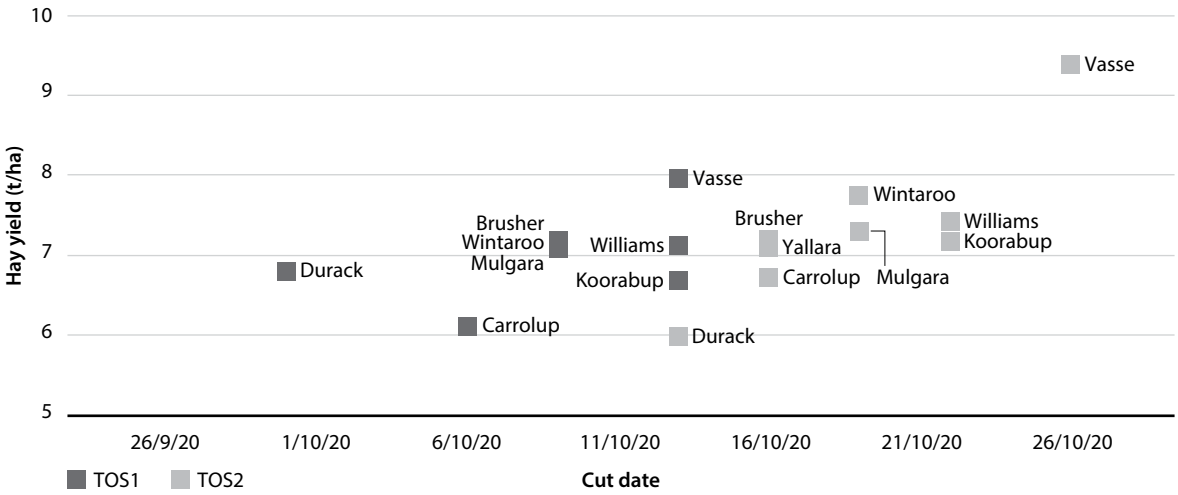

Figure 3. Oaten hay yield response to time of sowing, Rupanyup 2020. TOS x Variety: P=0.002, LSD=0.63t/ha, CV=7.9%.

Nitrogen response

An interaction between variety and nitrogen rate indicated there were different sensitivities by varieties to applied N (Figure 4).

Across the nine varieties, hay yield increased as N rate increased (Figure 4). All varieties responded when N rate increased from 30 to 60kg N/ha. Hay yield was optimised for Carrolup and Koorabup at 60kg N/ha, while other varieties responded to an N rate increasing from 60 to 90kg N/ha.

Largest responses to increasing N from 30 to 60kg N/ha were by Vasse, Yallara and Koorabup, and to increasing N from 60 to 90kg N/ha were Vasse, Brusher and Wintaroo.

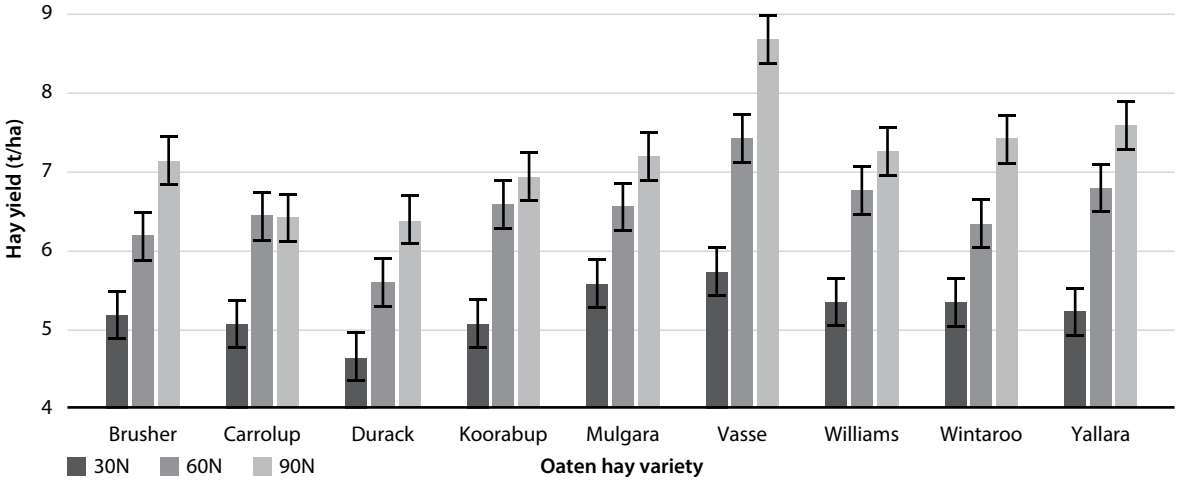

Figure 4. Mean oaten hay yield response to three nitrogen rates, Rupanyup 2020. Stats: P=0.045, LSD=0.62t/ha, CV=7.9%.

The better season finish in 2020 (compared with a drier finish at Kalkee in 2019) enabled larger responses to nitrogen. For Mulgara, Wintaroo and Yallara that received six rates of N up to 150kg N/ha, hay yield increased with N rate up to 90kg N/ha for Yallara, while Mulgara and Wintaroo responded to a further 30kg N/ha to optimise hay yields at 120kg N/ha (Figure 5).

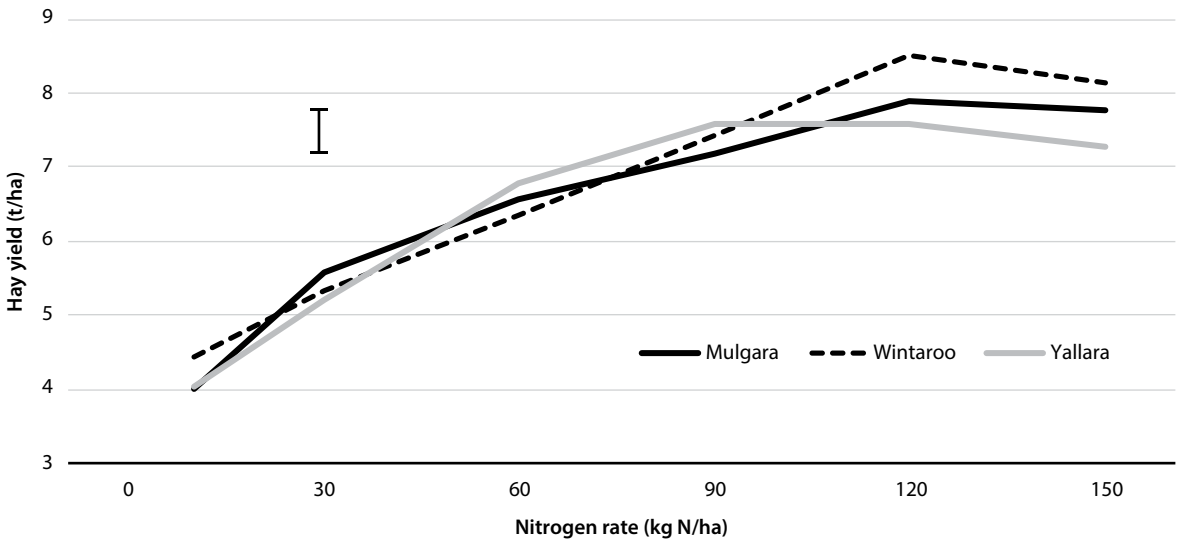

Figure 5. Mean oaten hay yield response to six nitrogen rates, Rupanyup 2020. Stats: P=0.007, LSD=0.59t/ha, CV=6.9%.

Time of sowing x Nitrogen rate

For Mulgara, Wintaroo and Yallara that received six rates of N up to 150kg N/ha, hay yield responded to later time of sowing for lower nitrogen rates 10, 30 and 60kg N/ha. Once N rate was above 90kg N there was no response to time of sowing (Table 2), likely due to there being more mineralisation of soil N by TOS 2 in late May and therefore less response to higher rates of applied N. Across both sowing times, hay yield optimised at 120kg N/ha.

Table 2. Oaten hay yield response to N rate and time of sowing, Rupanyup 2020.

TOS	Nitrogen rate (kg N/ha)					
	10	**30**	**60**	**90**	**120**	**150**
1	3.7^{g}	4.9^{f}	6.1^{e}	7.4^{cd}	8.0^{ab}	7.5^{bc}
2	4.6^{f}	5.8^{e}	7.0^{d}	7.4^{cd}	8.0^{a}	8.0^{ab}
Sig. diff.			**0.004**			
LSD (P=0.05)			**0.50**			
CV%			**6.9**			

Hay quality

Plant height

Plant height was influenced by TOS (P=0.002), variety (P<0.001) and N rate (P<0.001). Early May sown plants averaged 73cm in height compared with late May sown plants at 79cm. Wintaroo and Brusher were tallest at 86 and 84cm respectively. While yielding highest, Vasse had the shortest height at 69cm, close to Durack at 71cm but lower than all other varieties. As N rate increased from 30 to 60kg N/ha plant height increased by 5cm, then a further 3cm to 90kg N/ha.

Lodging

No crops lodged in 2020.

Leaf greenness (SPAD chlorophyll measure)

Greenness of hay is a desired quality trait, indicating plant health and conditions for hay during curing and baling. Variety colour measurements (SPAD) were affected by TOS (P<0.001), with the plants sown in late May measuring greener for Brusher, Mulgara and Wintaroo. Durack, Williams, Vasse and Koorabup measured highest SPAD, and Yallara lowest. Increasing N rate from 30 to 60 to 90 increased SPAD (P<0.001) but there was no SPAD response interaction between N rate with variety or TOS.

Stem thickness

Thinner stems (<6mm) with lower fibre and higher water-soluble carbohydrates make better quality hay. Stem diameter for all treatments met this quality target, ranging from 3.8mm to 5.2mm, driven by the high target plant density of 320 plants/m^2 (sowing rates ranged from 138 to 177kg/ha). There was a stem diameter response to TOS by variety (P=<0.001). Varieties Williams and Wintaroo responded strongest to later sowing with reductions in stem thickness of 1.0 and 0.8mm respectively (Table 3). There were no differences in stem diameter between sowing times for other varieties.

Table 3. Stem diameter of oaten hay varieties at two times of sowing, Rupanyup 2020.

TOS	Oaten hay variety								
	Brusher	**Carrolup**	**Durack**	**Koorabup**	**Mulgara**	**Vasse**	**Williams**	**Wintaroo**	**Yallara**
1	4.3^{def}	4.1^{fg}	4.5^{bcdef}	4.2^{efg}	4.9^{ab}	4.8^{abc}	5.2^{a}	4.6^{bcde}	4.4^{cdef}
2	4.1^{efg}	4.4^{cdef}	4.5^{bcdef}	4.2^{efg}	4.8^{abcd}	4.8^{abc}	4.2^{fg}	3.8^{g}	4.2^{efg}
Sig. diff.					**0<0.001**				
LSD(P=0.05)					**0.4mm**				
CV%					**9.8**				

Varieties Koorabup, Wintaroo, Brusher, Carrolup and Yallara had the finest stems between 4.2mm and 4.3mm. Vasse and Mulgara were the thickest at 4.8mm. Although Vasse was below the industry standard of 6mm, Vasse is not preferred by hay processors as the stems can be too thick when attention to seeding density is not taken. Stem thickness did not respond to nitrogen rate.

COMMERCIAL PRACTICE AND ON-FARM PROFITABILITY

Both the Rupanyup and Curyo oaten hay sites received below average rainfall across the growing season months May to September, except August rainfall at Rupanyup. Despite receiving more rain, Rupanyup grew 6.3t/ha on the clay soil barley stubble site (mid-April PAW 49mm, profile nitrogen 70kg/ha) compared with Curyo yielding 7.5t/ha on a sandy clay fallow with higher soil moisture and nitrogen (end March PAW 137mm, profile nitrogen 282kg/ha).

Two seasons in the Wimmera (Kalkee and Rupanyup) with different springs have produced different oaten hay yield and quality responses to agronomy treatments. With the drier spring in 2019, crops sown earlier yielded higher, faster varieties generally did better and crop yields were optimised at a lower nitrogen rate of 60kg/ha. With a favourable start and finish but dry winter, delaying sowing until the end of May grew more hay, longer season varieties Vasse and Wintaroo performed better and yields were optimised by higher nitrogen at 90kg/ha.

The challenge is to make sowing decisions that will be favoured by the season forecast and then for that forecast to happen. Over the past two seasons, the spring forecast has eventuated, although nerves have been tested along the way. Time of sowing and variety decisions must be made at sowing, and nitrogen rate should be decided and applied by GS25 (tillering) to GS31 (stem elongation): about six weeks after sowing.

The trial will be conducted for a third time in the Wimmera in 2021 to evaluate the varieties, TOS and N rate effects in a further set of seasonal conditions. Results from similar trials nationally will be collated to produce guidelines for agronomy to optimise hay quality in different seasons and regions across Australia.

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ACKNOWLEDGEMENTS

This research is part of the 'National Hay Agronomy project', funded by the AgriFutures™ Export Fodder Program. It is a national collaboration between DPIRD, SARDI, Agriculture Victoria, NSW DPI and grower groups including BCG.